Practice 1: Find $R_{th}$, $V_{th}$ for the two terminal circuit

\[ R_{th} = \frac{4 + 3}{(2 + 4)} = 6 \Omega \]

\[ V_{th} = V_y + V_x = 3I + 5 + 4 \times 5 \]

To find $I$, use mesh analysis

\[ 3I + 5 + 4(I - 5) + 2I = 0 \]

\[ 9I = 15, \quad I = \frac{5}{3} \]

\[ V_{th} = 3 \times \frac{5}{3} + 25 = 30 \text{V} \]

Practice 2: Find $R_{th}$, $V_{th}$ for the two terminal circuit

No independent source. $V_{th} = 0$.

To find $R_{th}$, supply 1V.

\[ i_x = -1/2A, \quad i_4 = 1/4 \]

\[ i_3 = i_x + 2I_x - i_x = 1/4 - 1/2 = -1/4A \]

\[ R_{th} = 1/I_0 = 4 \Omega \]

Negative resistance due to dep source.
Practice 3: Find $R_{th}$, $V_{th}$ for the two terminal circuit

![Circuit Diagram](image)

- $V_{th} = v_2 - v_3$
- By voltage division, $v_3 = \left(\frac{3}{5}\right) \times 10 = 6V$;
- $v_2 = 4V$
- By Ohms low, $v_x = 2 \times v_2 = 16V$;
- $V_{th} = 16 - 6 = 10V$

For $R_{th}$ supply 1A

![Circuit Diagram](image)

- $v_x = \frac{1}{\left(\frac{2}{3}\right)} = 1.2V$,
- $v_1 = 2(2v_1 + 1) = 6.8V$,
- $v_0 = v_x + v_2 = 13V$,
- $R_{th} = v_0 / 1 = 13\Omega$

Practice 4: Find the Norton’s equivalent

![Circuit Diagram](image)

- $R_N = 20 + 40 / 10 = 28\Omega$
- It is easier to find $V_{th}$, then $I_{th} = V_{th} / R_N$
- $V_{th} = v_1 + v_2$
- $v_x = 20 \times 3 = 60V$
- Same current in 10\Omega and 40\Omega.
- By voltage division, $v_x = \left(\frac{40}{50}\right) \times 40 = 32V$,
- $V_{th} = v_x + v_2 = 92V$;
- $I_{th} = 92 / 28 = 23/7\Omega$
Practice 5: Find the value of $R_L$ so that maximum power is delivered. Also find the maximum power.

\[ V_{th} = v_2 + 4 \]

To find $v_2$, use mesh analysis.

\[ 2i_x + 2i_x + 4 - 3i_x = 0 \]
\[ i_x = -4A \]
\[ V_{th} = 2i_x + 4 = 4V \]

The maximum power is delivered when $R = 5\Omega$. The maximum power is

\[ p_{max} = \frac{V_{th}^2}{4R_{th}} = \frac{16}{20} = 0.8W \]

Practice 6: Find the unknown $R_L$ so that maximum power is delivered. Also find the maximum power.

\[ V_{th} = v_2 + v_6 \]

By voltage division, $v_{20} = \frac{20}{100} \times 40 = 8V$, $v_{60} = \frac{60}{100} \times 40 = 24V$
\[ V_{th} = 8 - 24 = -16V \]

For $R_{th}$, turn off 40V with short circuit. Then $R_{th} = 20/80 + 40/60 = 16 + 24 = 40\Omega$

The maximum power is delivered when $R_L = R_{th} = 40\Omega$,

\[ p_{max} = \frac{4 \times 40}{16} = 1.6W \]
Practice 7: Find the unknown R so that maximum power is delivered. Also find the maximum power.

\[ V_{th} = 10I_x - v_1 = 10I_x - 5I_x = 5I_x \]

Use mesh analysis to find \( I_x \).
By KVL, \( 5I_x + 10 + 5I_x - 10I_x + 10(I_x - 2) = 0 \), \( I_x = 1A \);
\( V_{th} = 5I_x = 5V \).

To find \( R_{th} \), turn off 2A, 10V and supply \( v_0 = 15V \). Then \( R_{th} = 15/I_0 \)

\[ I_x = 15/(10+5) = 1A; \]
\[ I_1 = (15 - 10I_x)/5 = 1A \]
\[ I_0 = I_1 + I_x = 2A \]
\[ R_{th} = 15/2 = 7.5\Omega \]

The maximum power is delivered when
\( R = 7.5\Omega \);
\[ P_{max} = 5^2/(4 \times 7.5) = 5/6W \]